A new annual species of *Senecio* (Compositae-Senecioneae) from subnival zone of southern Iran with comments on phytogeographical aspects of the area

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Abstract

A new species of *Senecio* sect. *Senecio* (Compositae-Senecioneae), viz. *Senecio subnivalis* Y. Ajani, J. Noroozi & B. Nord. sp. nov., from subnival zone of Hezar mountain (Kerman Province), in the south of Iran, is described and illustrated. Distribution map and morphological comparisons of the species with its close relatives, *Senecio eligulatus* B. Nord., Moussavi & Djavadi, *S. iranicus* B. Nord., *S. kotschyanus* Boiss., and *S. dubitabilis* C. Jeffrey & Y. L. Chen (syn. *S. dubius* Ledeb.) are given. The new species differs from these species mainly in size and shape of ligulate florets, leaf morphology, and pubescence of cypsela and vegetative parts. The accompanying species of *Senecio subnivalis* and some ecological features of its habitat are mentioned. The phytogeographical aspects of Hezar-Lalehzar mountains are discussed and distribution maps of 15 species are presented.

Keywords: Iran, new species, *Senecio*, subnival zone, phytogeography, endemism.

Fig. 1. Position of the Hezar-Lalehzar Mountains and adjacent mountain ranges.

Fig. 2. (a) *Senecio subnivalis.*
(b) *Artemisia persica* community, the habitat of the new species at 4443m (photos J. Noroozi).

Introduction

Compositae (Asteraceae) is the largest plant family in the flora of Iran (Rechinger 1963–2007, Ghahreman & Attar 1999, Jalili & Jamzad 1999). In the tribe Senecioneae the largest genus is *Senecio* L. with an almost cosmopolitan distribution and well over 1,000 species (Nordenstam 2007, Pelser et al. 2007, Nordenstam et al. 2009). In *Flora Iranica* (Nordenstam 1989) 25 species of *Senecio* were recorded. After transfers to the segregated genera *Jacobaea* Mill. and *Iranecio* B. Nord. and the description of one new species, twelve Iranian species of *Senecio* s.str. remain. Among those, six species are distributed in alpine and subnival mountain areas. Four of these species are local endemics, viz. *S. vulcanicus* Boiss., *S. iranicus* B. Nord., *S. kotschyanus* Boiss. and *S. eligulatus* B. Nord., Moussavi & Djavadi (Nordenstam 1989, Assadi 1992, Moussavi et al. 2001, Nordenstam et al. 2002).

This paper is based on a field expedition in 2009 to the poorly investigated alpine and subnival zone of Hezar-Lalehzar Mountains. These mountains with a highest elevation of 4465 m a.s.l. are isolated and located in the south of the country (Kerman Province) and surrounded by semi-desert lowlands (Fig. 1). The alpine and subnival plants of these mountains were first collected by Bornmüller in 1892. Freitag & Kuhle (1980) published a list of woody elements with ecological remarks of Jupar Mountain, which is located in the northern part of the range. The rate of endemism is high in these mountains especially at high altitudes. In recent years, *Senecio eligulatus* B. Nord., Moussavi & Djavadi (Nordenstam et al. 2002) and *Ferula hezarlalehzarica* Y. Ajani (Ajani & Ajani 2008) were described from this region.

Of the twelve Iranian *Senecio* species, seven species are annual, viz., *S. vulgaris* L., *S. vernalis* Waldst. & Kit., *S. glaucus* L., *S. kotschyanus*, *S. flavus* (Decne.) Sch. Bip., *S. eligulatus* and *S. iranicus* (Nordenstam 1989, Nordenstam et al. 2002, Moussavi et al. 2001). Since the new species showed some similarities especially to *S. iranicus* and *S. kotschyanus* and also somewhat to *S. eligulatus* and *S. dubitabilis* C. Jeffrey & Y. L. Chen (1984) we compared it with the mentioned taxa (Table 1). The latter species was included in the *Flora Iranica* (Nordenstam 1989) in the key but without any description, since it has not yet been recorded from Iran. It has been treated (as *S. dubius* Ledeb.) in the *Flora USSR* (Schischkin 1961), *Flora of West Pakistan* (Nasir & Ali 1972), and *Flora of Kazakhstan* (Pavlov 1966).

Material and Methods

The new species was discovered during a botanical excursion of first and second authors in the alpine to subnival zones of Hezar-Lalehzar mountains in late July 2009. A phytosociological relevé (size 100m²) according to Braun-Blanquet method (Braun-Blanquet 1964) was sampled from the habitat of the new species (altitude 4443 m) to identify associated species. The ecological characteristics of the habitat were recorded. For distribution ranges of the relevant species, *Flora Iranica* (Rechinger 1963–2007) and other recent monographs and revisions have been used.

Herbarium abbreviations follow Thiers, with the addition of the new acronym ACECR for Central Herbarium of Medicinal Plants, Iranian Academic Centre for Education, Culture and Research, Karaj, Iran.

Results and Discussion

***Senecio subnivalis* Y. Ajani, J. Noroozi & B. Nord., sp. nov.** (Figs. 2a, 3).

TYPE: Iran, Kerman Province, Rayen, Mt. Hezar, on the north side of summit, 29°30′44″N, 57°16′20″E, 4443 m, Y. Ajani & J. Noroozi 396 (IRAN, holotype; ACECR, S, TARI, TUH, isotypes).

Herba annua erecta parva 1.5–5 cm alta laxe albolanata vel subglabra. Folia caulina sessilia integra vel paucidentata aut breviter lobata, spathulata–oblanceolata vel oblonga, apice obtusa–rotundata. Capitula solitaria vel pauca, pedunculata, heterogama. Involucrum anguste campanulatum–subcylindricum; involucri bracteae uniseriatae 8–9 lineares purpurascentes. Flosculi radii pauci inconspicui, corolla breviter ligulata, lamina 0.5–1.5 mm longa. Flosculi disci hermaphroditi; corolla tubulosa superne anguste campanulata 5-loba; lobi triangulari-ovati apice papillati. Antherae appendice anguste ovata obtusa incluso c. 1 mm longae, basi breviter sagittatae ecaudatae. Styli rami apice truncati pilis everrentibus breves. Cypselae anguste elliptico-oblongae 8–10-costatae puberulae. Pappi setae numerosae albae caducae.

Dwarf annual herb. Stems erect, 1.5–5 cm high, simple or branched, green or purplish, subglabrous or sparsely pubescent with lax, long white hairs. Leaves alternate, sessile, usually spathulate–oblanceolate or sometimes linear, 7–22×2–4 mm, entire or with few teeth or lobes, sparsely thinly pubescent, apex obtuse to rounded. Upper leaves similar to basal leaves but smaller, 4–7 mm long, ± lanceolate. Capitula heterogamous, single or 2–3 in lax corymb; peduncles 7–12 mm, laxly pubescent with long white hairs. Involucre narrowly campanulate–subcylindrical, 6–7 mm high, 3–4 mm wide; phyllaries uniseriate, 8–9, narrowly

oblong-lanceolate, 5.5–6×1 mm, herbaceous, with narrow membranous margins, glabrous or with a few scattered hairs, 1–3-nerved, distinctly purplish, apically acute and puberulous; calyculus bracts few (2–3), 1–2 mm long, narrowly lanceolate. Receptacle flat, glabrous, minutely alveolate. Ray-florets 1–5, female, shortly ligulate; tube cylindric, 1–1.5 mm long, greenish-yellow, glabrous; lamina narrowly elliptic-oblong, 0.5–1.5 mm long, 0.5–0.7 mm wide, yellow, indistinctly veined, apically entire or bifid; style overtopping lamina, style branches 0.7–1 mm long, obtuse; disc-florets 10–15, hermaphroditic; corolla yellow, 3.5–4 mm, tubular and only gradually somewhat widening upwards, 5-lobed; lobes narrowly ovate, ca. 0.5 mm, midlined, apically papillate. Anthers 1 mm long, ecaudate, shortly sagittate; apical appendage narrowly ovate, obtuse; endothecium radial (cells elongate with thickenings on vertical walls); filament collar balusterform. Style branches linear-oblong, 0.5–0.8 mm long, apically truncate with short sweeping-hairs, stigmatic surfaces separated. Cypselas narrowly elliptic-oblong, 3–4 mm long, 1–1.5 mm wide, faintly 8–10-ribbed, sparsely puberulous with short obtuse duplex hairs. Pappus bristles numerous, white, 2.5–3.5 mm long, slender, minutely barbellate, caducous.

General distribution: Endemic to southern Iran (Fig. 5n).

Phenology: Flowering in mid–late July.

The morphological differences among *S. subnivalis, S. iranicus, S. eligulatus, S. dubitabilis* and *S. kotschyanus* are summarized in Table 1.

The new species might be confused with *S. dubitabilis* (which is not yet recorded from Iran; cf. above), but is distinguished by its ligulate though inconspicuous ray-florets. In the latter species the capitulum is truly discoid with all florets hermaphroditic and tubulate. Further examination of the species indicated perhaps more affinities with *S. eligulatus, S. kotschyanus* and *S. iranicus*. All of these have heterogamous capitula. The new species differs from *S. eligulatus* by its smaller size and by having single or few capitula, entire or paucilobate smaller leaves, and ray-florets glabrous with a short but distinct lamina. In *S. eligulatus*, capitula are more numerous, involucres broader with more numerous phyllaries, the leaves are pinnately lobate and larger, and the plant is taller, viz., 10–25 cm. Furthermore, the rayflorets of *S eligulatus* are reduced to a short puberulous tube without a lamina (Nordenstam et al. 2002 Fig. 1C).

S. subnivalis is also close to *S. iranicus* which is likewise a dwarf annual of subnival zone, but locally endemic to Damavand on the Alborz (Elburz) Mountains (Nordenstam 1989). The significant differences between these species are cypsela pubescence, present in the new species but absent in *S. iranicus*, and the usually eight ray-florets with well-developed lamina in the latter species. The differences from *S. kotschyanus*, which is locally endemic to alpine areas of Dena Mts. (south

of Zagros), are also mainly in pubescence. In the new species the pubescence consists of lax and long hairs while *S. kotschyanus* has a more dense, partly copious hair-cover. For further differences, see Table 1.

Ecological aspects: *S. subnivalis* grows in real subnival zone with harsh climatic conditions. The ground is covered with large and small scree (ca. 85%). The vegetation cover is around 10% (Fig. 2b, Table 2).

Accompanying species: *Artemisia persica*, *Scrophularia subaphylla*, *Asperula glomerata* subsp. *condensata*, *Potentilla nuda*, *Ranunculus eriorrhizus*, *Astragalus melanodon*, *Nepeta lasiocephala*, *Veronica kurdica* subsp. *filicaulis*, *Psychrogeton alexeenkoi* and *Silene daenensis*.

Phytogeography and Conservation

Hezar-Lalehzar Mts. are biogeographically situated on the border between two important vegetation units, viz. the Irano-Turanian semi-desert *Artemisia* steppes and the northern Saharo-Arabian regions (Zohary 1973). The vegetation of these mountains from the lowlands to the summit of Hezar (4465 m) is dominated by *Artemisia* steppe, and the dominant species in the alpine and subnival zones is *Artemisia persica* (Fig. 2b). The phytogeographical patterns and relations in the high altitude areas of Iran differ from those of the lower regions (Noroozi et al. 2008). Whereas the lowland flora of the region is influenced by Saharo-Arabian elements (Zohary 1973, White & Léonard 1991, Akhani 1994, 1997), the high altitude flora, especially of the alpine and subnival zones, is completely composed of Irano-Turanian elements. According to previous records and our own field work in this area, at least 28 taxa reach the subnival zone of these mountains, viz., *Senecio subnivalis*, *Arenaria minutissima*, *Tanacetum pamiricum*, *Artemisia persica*, *Cousinia fragilis*, *Psychrogeton amorphoglossus*, *P. alexeenkoi*, *Taraxacum primigenium*, *Crepis heterotricha* subsp. *heterotricha*, *Draba aucheri*, *Arabis caucasica*, *Kobresia humilis*, *Oxytropis kermanica*, *Astragalus tenuiscapus*, *A. melanodon*, *Acantholimon haesarense*, *Primula algida*, *Scrophularia subaphylla*, *Veronica kurdica* subsp. *filicaulis*, *Potentilla nuda*, *Ranunculus eriorrhizus*, *Trachydium depressum* subsp. *depressum*, *Asperula glomerata* subsp. *condensata*, *Veronica biloba*, *Nepeta lasiocephala*, *Silene nurensis*, *Silene daenensis* and *Gagea* sp.

All species mentioned are Irano-Turanian elements. 11% of them are endemic to Hezar-Lalehzar Mts., 27% to south-east Zagros, 50% to Zagros and 62% to Iran. Fig. 4 shows biogeographical relationships of vascular plants occurring in the subnival belts of Hezar-Lalehzar mountains and adjacent ranges. In spite of the high rate of species endemic of Iran (62%), the floristic relationships with

Hindu-Kush and Central Asia are remarkable (ca. 30% for both).

Six main distribution patterns for the subnival species of these mountains can be recognized:

1- Wide distribution from Zagros and Alborz to Hindu-Kush and/or Central Asia and Himalaya. Some examples are *Trachydium depressum* (see distribution map in Noroozi et al 2008: Fig. 7d), *Draba aucheri, Primula algida* and *Kobresia humilis*. The importance of Central Asia as a source for the flora of the whole Irano-Turanian region was stressed by Wendelbo (1971).

2- Close floristic and phytogeographical relationship of Zagros and especially the mountains of southern Iran with Hindu-Kush and Central Asia. This pattern was demonstrated by Wendelbo (1971), Hedge & Wendelbo (1978) and Noroozi et al. (2008). The recently described *Ferula hezarlalehzarica* (Apiaceae) from Hezar-Lalehzar mountains, e.g. has close affinity to *F. koso-poljanskyi* and *F. hindukushensis* in Central Asia and Hindu-Kush mountains (Ajani & Ajani 2008). In the subnival zone of these mountains some species are Central Asian and Hindu-Kush elements with a disjunct distribution in Iran and reach their westernmost extension in central and northern Zagros (e.g., *Artemisia persica* [Fig. 5a]), south-east Zagros (e.g., *Psychrogeton alexeenkoi* [Fig. 5b]), or Hezar-Lalehzar Mts. (e.g., *Tanacetum pamiricum*).

3- Distribution across Iranian mountains. Several taxa are distributed in Zagros and Alborz and sometimes Kopet Dagh, such as *Potentilla nuda* (Fig. 5c), *Scrophularia subaphylla* (Fig. 5d) and *Oxytropis kermanica.*

4- Distribution across Zagros. The phytogeographical importance of such patterns was noted by Hedge & Wendelbo (1978), Akhani (2004, 2007) and Noroozi et al. (2008). Some taxa of the subnival zone are distributed from Hezar-Lalehzar and adjacent mountains to central and/or northern Zagros, such as *Crepis heterotricha* subsp. *heterotricha* (Fig. 5e), *Taraxacum primigenium* (Fig. 5f), *Silene daenensis, S. nurensis* (Fig. 5g), *Veronica kurdica* subsp. *filicaulis* (see distribution map in Noroozi et al. 2008: Fig. 8a), *Astragalus melanodon* and *Asperula glomerata* subsp. *condensata,* which well justifies the Zagros as a separate province as suggested by Akhani (2007) and Noroozi et al. (2008).

5- Distribution in the southern mountains of Iran (south-east Zagros). There is a strong link between Kerman, Shiraz and Yazd mountains in south Iran. In the subnival flora some species show this link, e.g., *Nepeta lasiocephala* (Fig. 5i), *Ranunculus eriorrhizus* (Fig. 5j), *Astragalus tenuiscapus* (Fig. 5k) and *Arenaria minutissima* (Fig. 5l). In addition to the mentioned species, some others, which belong to the alpine flora, have similar distribution patterns, e.g., *Astragalus rufescens* (Fig. 5h), *Arenaria bulica, Silene caroli-henrici, Cousinia longifolia*

(see distribution map in Noroozi et al. 2008: Fig. 11e), *C. sicigera, Chamaegeron asterellus, Scorzonera intricata* (see distribution map in Noroozi et al. 2008: Fig. 11g), *Stachys obtusicrena* (see distribution map in Noroozi et al. 2008: Fig. 11h), *Nepeta dschuparensis, N. glomerulosa* subsp. *carmanica, Cotoneaster persica, Potentilla poteriifolia, Ranunculus papyrocarpus, Onobrychis plantago, Astragalus abditus, A. confertiformis, A. heterodoxus* and *A. pseudoshebarensis*. The rate of local endemism in mountains of this area is remarkable too. The southern mountains of Iran (south-east of Zagros), which are strongly influenced by the aridity of central and southern Iranian and Arabian climate, are therefore suggested as a subunit of Zagros province.

6- Local endemics of Hezar-Lalehzar mountains (i.e., within the range of *Rubia caramanica,* Fig. 5m). The most important phytogeographical aspect of these mountains is the high rate of local endemism. Some subnival species which are local endemics of these mountains are *Cousinia fragilis, Acantholimon haesarense* and *Senecio subnivalis* (Fig. 5n). There are also many locally endemic species restricted to the subalpine and alpine zones of these mountains, such as *Allium cathodicarpum*, *A. lalesaricum*, *Nepeta rivularis*, *N. bornmuelleri*, *Dracocephalum polychaetum*, *Polygonum spinosum, Dionysia oroedoxa*, *D. rhaptodes, Leucopoa pseudosclerophylla, Acantholimon cupreo-olivascens*, *A. albocalycinum*, *A. kermanense, A. sirchense, Verbascum carmanicum*, *Semenovia suffruticosa*, *Rubia caramanica*, *Senecio eligulatus, Astragalus carmanicus*, *A. hezarensis* and *A. lalesarensis*. Most of these species are known only from their type location. The high rate of endemism indicates that these mountains could be recognized as a local center of endemism. The area is botanically less known and we strongly recommend detailed floristic and vegetation studies which may result in further taxa new to science or to Iran and which will clarify the biogeography of the region.

Mountains are hotspots for biodiversity and priority regions for conservation, because a single mountain may host a series of climatically different life zones over short elevational distances (Körner 2004). The distribution and ecology of endemics differ considerably from overall biodiversity patterns and must be addressed appropriately in conservation strategies (Essl et al. 2009). The southern Zagros has a very long history of land use (Djamali et al. 2009). In spite of a high rate of local endemism, especially in high altitudes of these mountains the protection of nature is very poor. The most important threat to the flora and vegetation of the region is high pressure of overgrazing, particularly by sheep and goat herds. Like other mountains of the country, these mountains are used as spring and summer pastures. Every year in the warm season, overcrowded herds are moved from adjacent lowland and deserts to high altitudes of these mountains with very poor control, resulting in threats to the narrowly distributed species and

the natural vegetation, particularly in the fragile subalpine and alpine zones. The pressure of grazing is lower in subnival habitats. However, the smaller altitudinal distribution and the limited number of colonized habitats of very narrowly distributed endemics make these species especially vulnerable to climate change (Ohlemüller et al. 2008, Dirnböck et al. 2003). Especially in mountains like Hezar-Lalehzar where local endemic species cannot migrate to a nival zone (because of altitudinal limit of these mountains) or to other mountain ranges (because of the isolated situation), the risk of extinction increases by global warming. We strongly recommend the conservation of Hezar and Lalehzar mountains as protected area or National Park in order to protect the locally endemic species and vulnerable plant communities.

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Table 1. Morphological comparison between *Senecio subnivalis, S. eligulatus, S. iranicus* and *S. dubitabilis*.

Characters	***Senecio subnivalis***	***S. iranicus****[1]	***S. eligulatus****[2]	***S. dubitabilis****[3]	***S. kotschyanus****[4]
Height (cm)	1.5–5.5	1–4	10–25	5–30	1–5(–10)
Plant pubescence	Lax with scattered long hairs	Sparsely araneose to lanate	Lax pubescence esp. on peduncles and involucre	Glabrous or pubescent with white long hairs	Densely white-villous
Leaves (shape; margin; dimension)	Spathulate; entire or 2–3-lobate; 0.7–2.2×0.2–0.4 cm	Linear-oblanceolate; entire or dentate to pinnatilobate; 0.3–2 ×0.1–0.3 cm	Oblong, oblanceolate; pinnatilobate with dentate lobes: 2–5×1–2 cm	Spathulate, oblong–lanceolate-linear; entire or shortly pinnatilobed; 3–7×0.3–2 cm	Spathulate, oblanceolate; subentire, dentate or lobate; 1–3×0.1–0.8 cm
Capitula (number; sexuality)	Single or few; heterogamous	Single or few; heterogamous	Several–numerous; heterogamous	Few; homogamous	Single or few (rarely many); heterogamous
Phyllaries (number; shape; dimension; venation)	8–9; linear; 5–5.5×0.8–1 mm; with 3 distinct lines	11–15, oblong or linear-oblanceolate; 4–4.4×0.7–2 mm; 1(–3) indistinct lines	11–13, linear-lanceolate, 5–8×1 mm, with 2–3 distinct lines	15, linear-oblong–lanceolate, 5–10 mm, with 3 distinct lines	8–14; oblong or oblong–lanceolate; 5–7.5×0.7–1.2; with single distinct line

Marginal female florets (number; shape)	1–5; lamina narrowly elliptic-oblong–linear, 1.5×0.5 mm, entire or bifid, indistinctly veined	8; lamina oblong or elliptic-oblong, 3.5–6×1.4–3 mm, 4-veined, minutely 3-fid	Few (1–5?); lamina absent; corolla reduced to a narrow puberulous tube 1.5 mm long	Absent	5–6; lamina oblong, 1.5–3×1–2 mm, distinctly 3-lobed
Cypselas (length; pubescence)	3 mm; sparsely appressed villous with short duplex hairs	2.4–2.8 mm; glabrous	2 mm; puberulous with appressed short hairs	3–3.5 mm; Densely shortly villous	3.5 mm; appressed villous between ribs with short setiform hairs

*[1] data from Nordenstam (1989).

*[2] data from Nordenstam et al. (2002).

*[3] data from Schischkin (1961); Pavlov (1961); Jeffrey & Chen (1984); Nasir & Ali (1972).

*[4] data from Nordenstam (1989) and Moussavi et al. (2001).

Table 2. Species composition of the *Artemisia persica* community (habitat of *Senecio subnivalis*) based on one phytosociological relevé from subnival zone of Hezar mountains, north slope of the highest peak. The symbols show cover-abundance of each species according to the method of BRAUN-BLANQUET (1964), where 1= <5% [or over 50 small plants or 1–5 large plants], += <1% [1–5 small plants].

Relevé	**1**
Coordinates:	29°30'44"N 57°16'20"E
Sample area (m^2)	100
Inclination(°)	20
Altitude (m)	4443
Aspect	NE
Vascular plants (%)	10
Scree (%)	85
Solid rock (%)	3
Bare ground (%)	2
Litter (%)	0.5
Richness	11

Species	**cover-abundance**
Artemisia persica	1
Asperula glomerata subsp. *condensata*	1
Nepeta lasiocephala	1
Astragalus melanodon	1
Ranunculus eriorrhizus	1
Senecio subnivalis	+
Potentilla nuda	+
Scrophularia subaphylla	+
Veronica kurdica subsp. *filicaulis*	+
Psychrogeton alexeenkoi	+
Silene daenensis	+

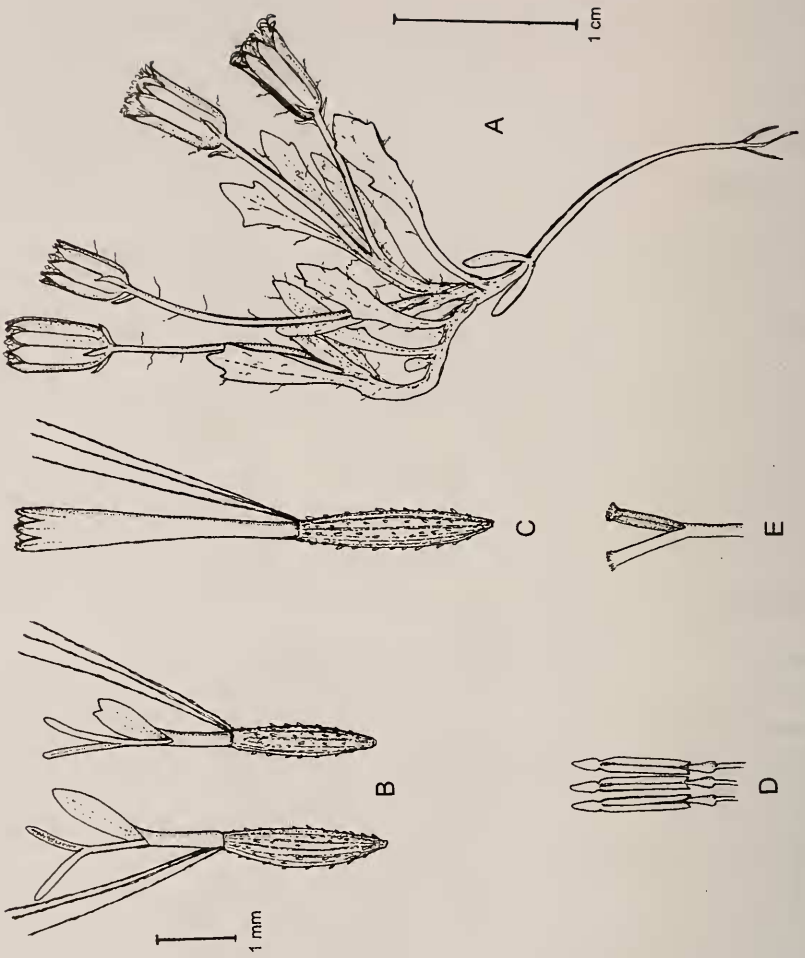


Fig. 3. *Senecio subnivalis*, drawn from isotype in S.
A Habit. B Ray-florets. C Disc-floret. D Stamens. E Style branches from disc-floret. Del. B. NORDENSTAM.

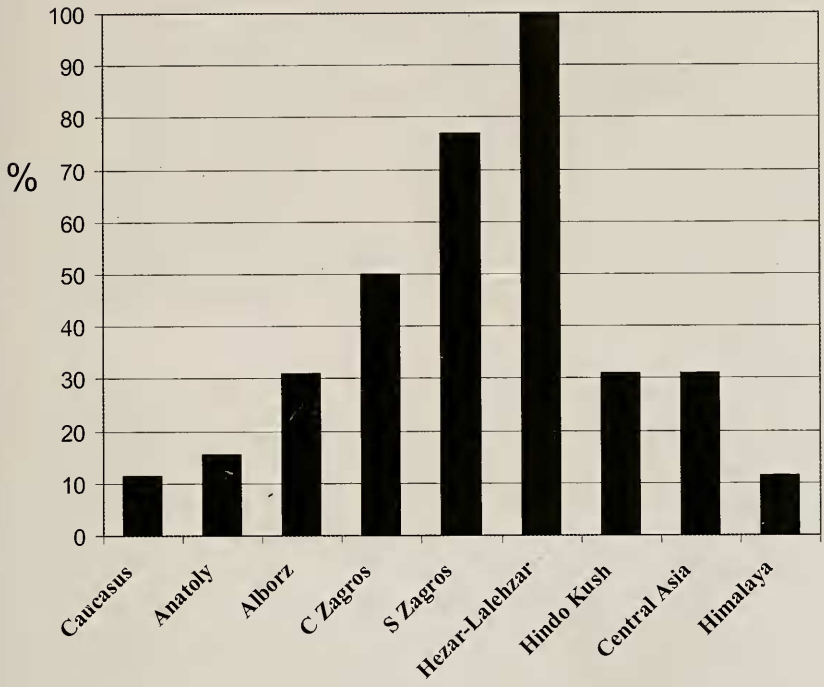
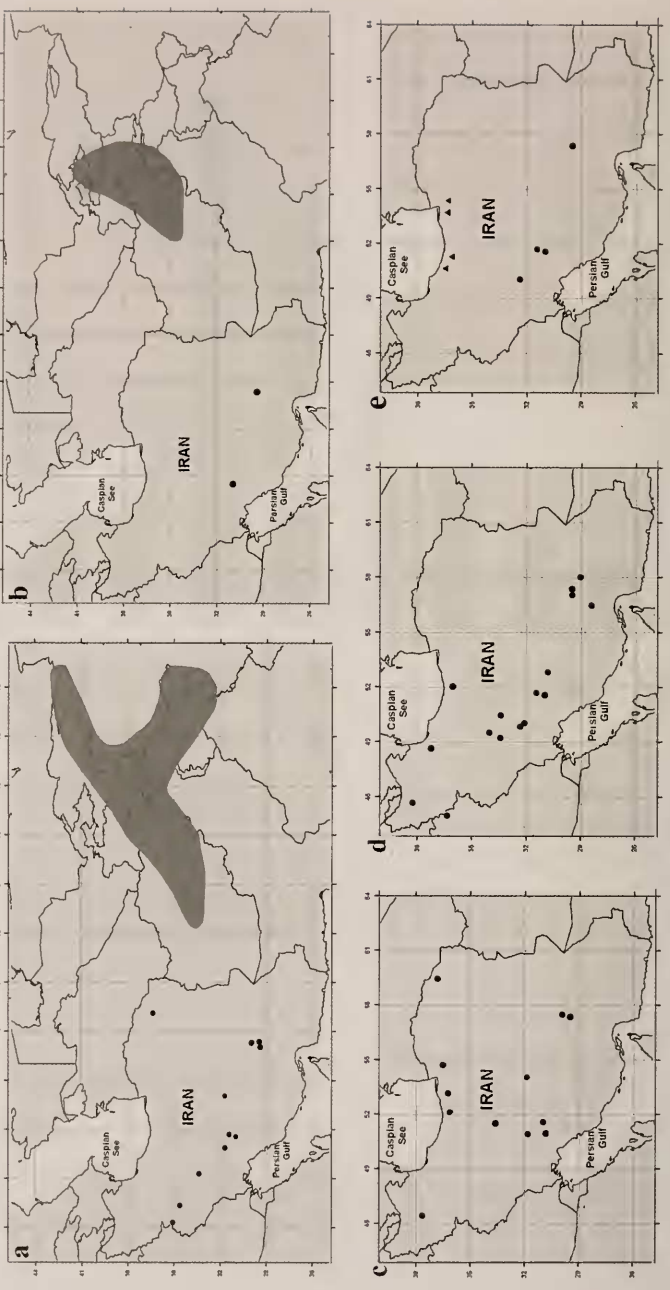


Fig. 4. Biogeographical relationships of vascular plants occurring in the subnival belts of Hezar-Lalehzar mountains with adjacent mountain ranges. (C Zagros= central and north of Zagros; S Zagros= south-east of Zagros except Hezar-Lalehzar Mts.).


a
IRAN
Caspian Sea
Persian Gulf
b
IRAN
Caspian Sea
Persian Gulf
c
IRAN
Caspian Sea
Persian Gulf
d
IRAN
Caspian Sea
Persian Gulf
e
IRAN
Caspian Sea
Persian Gulf

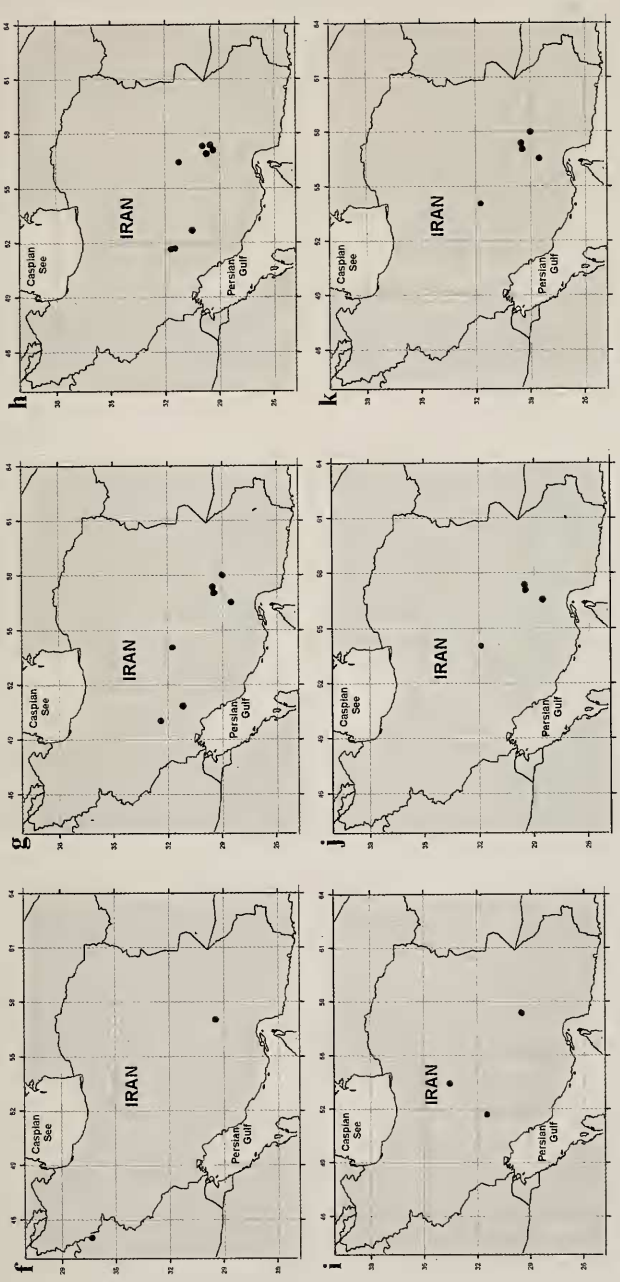

f
IRAN
Caspian See
Persian Gulf
g
IRAN
Caspian See
Persian Gulf
h
IRAN
Caspian See
Persian Gulf
i
IRAN
Caspian See
Persian Gulf
j
IRAN
Caspian See
Persian Gulf
k
IRAN
Caspian See
Persian Gulf

Fig. 5. Different distribution patterns of species occurring in subnival zone of Hezar-Lalehzar mountains: (a) *Artemisa persica*, (b) *Psychrogeton alexeenkoi*, (c) *Potentilla nuda*, (d) *Scrophularia subaphylla*, (e) *Crepis heterotricha* subsp. *heterotricha* (circle) subsp. *lobata* (triangle), (f) *Taraxacum primigenium*, (g) *Silene nurensis*, (h) *Astragalus rufescens*, (i) *Nepeta lasiocephala*, (j) *Ranunculus eriorrhizus*, (k) *Astragalus tenuiscapus*, (l) *Arenaria minutissima,* (m) *Rubia caramanica* (n) *Senecio subnivalis.*